REMARKS

Claims 1-29 are pending in the application with claims 7, 8, 18, and 19 amended herein merely to clarify that the NO_2 is reduced to N_2. The amendments made herein now more positively express limitations that were previously inherent in such claims and, accordingly, are not for the purpose of narrowing and do not effectively narrow the scope of any claim. Claims 30-42 stand withdrawn from further consideration.

Applicant hereby affirms the provisional election without traverse of Group I, claims 1-21 in an August 18, 2003 telephone conference with the Examiner.

Claims 1-29 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Penetrante '854, Penetrante '853, or Vogtlin. Applicant requests reconsideration.

Claim 1 sets forth a NO_x reduction method that includes, among other features, treating a first gas containing NO_x and producing a second gas containing NO_2, reducing a portion of the NO_2 in the second gas to N_2 and producing a third gas containing less NO_x than the first gas, treating the third gas and producing a fourth gas containing NO_2, and reducing a portion of the NO_2 in the fourth gas to N_2 and producing a fifth gas containing less NO_x than the third gas. Substantially all of the third gas NO_x is NO. Also, substantially all of the fifth gas NO_x is NO.

Page 4-6 of the Office Action allege that each cited reference teaches processes for treatment of nitrogen oxide that disclose all of the claim limitations except for treating the third gas and reducing a portion of the NO_2 in the fourth gas. The Office alleges that treating the third gas and reducing a portion of the NO_2 in the fourth gas is obvious unless the method of claim 1 can be shown to produce an unobvious nd product or ratio of gas components. Applicant ass rts that none of the cited references disclose or suggest substantially all of the third gas NO_x being NO and substantially all

of the fifth gas NO_x being NO, as s t forth in claim 1, and that such composition is not obvious. Also, Applicant asserts that the method of claim 1 provides unexpected advantages that are not obvious.

Review of the cited references does not reveal any evidence that they consider the composition of processed exhaust as of significant importance other than that it contain reduce amounts of NO_x. Figure 3 of each reference and the text associated therewith merely describes the processed exhaust as containing N_2 and O_2, indicating complete conversion of NO_2 and NO to N_2 and O_2. However, such a description of the processed exhaust composition ignores the realities of catalyst efficiencies. Both the Vogtlin and '854 reference use a catalytic converter 78 for selective catalytic reduction of NO_2 to N_2 and O_2. The '853 reference uses a catalytic storage reduction reactor 204 to convert NO_2 to N_2 and O_2. As described in paragraph [0019] of the present specification, prior investigations have not identified any catalysts demonstrating a NO_x conversion of 90 vol% or greater. Fig. 8 of Vogtlin and the associated text in column 11, lines 11-33 (and Fig. 8 of '854 and the associated text in column 9, lines 12-34) agree with and verify Applicant's statement in paragraph [0019] of the present specification.

Specifically, Fig. 8 in the two references demonstrates that, of the 500 ppm NO in the inlet gas, at least about 80 ppm of the inlet NO_x remains after completion of treatment. Even after applying an input energy density of 5 J/L, some of the input NO_x remains and higher input energy density does not improve the conversion efficiency. In addition, Fig. 8 shows that of the remaining NO_x, about 25 % was NO_2. Accordingly, the depictions, particularly in Fig. 3, that might suggest complete conversion to N_2 and

O_2 cannot be considered to accurately represent th inherent short comings of the methods described in the cited references.

Nowhere do the cited references disclose or suggest substantially all of the third gas and fifth gas NO_x being NO, as claimed. In addition, only the Applicant's own specification provides a teaching of a method capable of producing a third gas and a fifth gas where substantially all of the NO_x is NO, as set forth in claim 1. Paragraph [0027] and elsewhere in the specification provide examples of how such limitations set forth in claim 1 may be achieved. Review of the cited references does not reveal any catalyst, process, or apparatus that can be considered to disclose or suggest a method that involves substantially all of the third gas NO_x being NO, as claimed.

Also, the Office Action alleges that it would be obvious to treat the third gas and reduce a portion of the NO_2 in the fourth gas, however, such statement contradicts the Applicant's assertion regarding tendencies in the conventional processes set forth in paragraph [0020] of the present specification. Specifically, a conventional approach to resolving low catalyst efficiency is to apply more plasma energy and/or to use a larger volume catalyst bed. The cited references again agree with Applicant's characterization at least in column 10, lines 17-19 of Vogtlin and column 8, lines 19-21 of '854.

In discussing the NO_x reduction data presented in Fig. 4, Vogtlin and '854 state that the maximum NO_x reduction efficiency could be increased by increasing the amount of catalyst and/or decreasing the gas flow rate. The measures described by the cited references to increase reduction efficiency are equivalent to the Applicant's suggestion to use a larger volume catalyst bed since all have the effect of increasing the residence time of NO_x in the catalyst bed. Accordingly, Applicant asserts that no

suggestion or motivation can be identified in the cited art to modify their methods by repeating their process of treating nitrogen oxides.

Regardless of the allegation in the Office Action to the contrary, it is clear that a finding a obviousness requires that the suggestion or motivation to modify the express teaching of reference must be found in the prior art. The Office Action does not provide any evidence of such a teaching in the prior art and instead relies only upon the unsupported opinion of the Examiner that those of ordinary skill would be motivated to use many stages in the treatment process. At least for such reason, the cited references fail to disclose or suggest treating the third gas and reducing a portion of the NO_2 in the fourth gas to N_2, as set forth in claim 1.

A finding of obviousness requires that the cited art disclose or suggest every limitation of the claim. The cited references fail to disclose or suggest substantially all of the third gas and the fifth gas NO_x being NO. The cited references also fail to disclose or suggest treating the third gas and reducing a portion of the NO_2 in the fourth gas to N_2. All of the references are similarly deficient and combination thereof cannot be considered to disclose or suggest limitations that are absent from each. Since the references fail to disclose or suggest every limitation of claim 1, claim 1 is patentable.

Applicant further asserts, as described in paragraph [0020] that treating the third gas and reducing a portion of the NO_2 in the fourth gas may improve upon known methods by increasing the level of NO_x conversion as well as reducing energy consumption during treatment of the third gas for a given level of NO_x reduction. Additional details regarding such improvements are discussed in the present specification and summarized below.

Claims 2-9 depend from claim 1 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claim 4 sets forth that the first and third gases further contain hydrocarbon. Treating the first gas and reducing a portion of the NO_2 in the second gas provides oxidation of less than 50 vol% of the hydrocarbon in the first gas. Also, treating the third gas and reducing a portion of the NO_2 in the fourth gas provides oxidation of less than 50 vol% of the hydrocarbon in the third gas. Claim 5 depends from claim 4 and further specifies oxidizing less than 35 vol% of the hydrocarbon in the first and third gases. The subject matter of claims 4 and 5 is clearly distinguished from the express teachings of the cited references.

Column 6, lines 53-58 of '854 and column 8, lines 50-55 of Vogtlin directly contradict the subject matter of claim 4 and 5. Claim 4 states that treating the first gas and reducing a portion of the NO_2 in the second gas provide oxidation of less than 50 vol% of the hydrocarbon in the first gas. Notably, column 6, lines 29-49 of '854 and column 8, lines 27-46 of Vogtlin state that treating NO_x to produce NO_2 occurs in processor 74 of Fig. 3 and that reducing NO_2 to N_2 occurs in catalytic converter 78 of Fig. 3. The references also state that hydrocarbons are consumed by processor 74 and catalytic converter 78. The references further describe preferably controlling the flow of hydrocarbons to minimize any hydrocarbons that remain after passing through processor 74 and catalytic converter 78. That is, the references expressly describe that the process of treating NO_x to produce NO_2 and reducing NO_2 to N_2 should, as much as possible, consume hydrocarbons inlet into the system.

Oxidation catalyst 82 is provided in '854 and Vogtlin merely to address any excess hydrocarbons that are not consumed by processor 74 and catalytic converter 78

(i.e., the treating to produce NO_2 and reducing NO_2 to N_2). A person of ordinary skill must accordingly conclude that consumption of hydrocarbons preferably occurs in processor 74 (treating to produce NO_2) and catalytic converter 78 (reducing NO_2 to N_2). Such a teaching is in direct contradiction to the claim 4 limitation that treating the first gas and reducing a portion of the NO_2 in the second gas provides oxidation of less than 50 vol% of the hydrocarbon in the first gas. Also, such teaching in the references directly contradicts the claim 5 limitation of oxidizing less than 35 vol% of the hydrocarbon in the first gas. At least for such reason, the cited references do not disclose or suggest the subject matter of claims 4 and 5.

Also, for example, claim 6 sets forth that a fraction of the first gas NO_x treated to NO_2 in the second gas approximately equals a fraction of the third gas NO_x treated to NO_2 in the fourth gas. The Office Action alleges that it would be obvious to use many stages in the treatment process. However, claim 6 further limits the method of claim 1 to a particular process configuration where the treatment fractions are equal for the first gas NO_x and the third gas NO_x. Regardless of whether the cited references suggest repeating the process of treating nitrogen oxides, they do not provide any disclosure or suggestion of the method set forth in claim 6.

Paragraphs [0037] and the latter part of [0040] in the present specification describe that minimization of total energy usage for conversion of NO_x to NO_2 can be accomplished by using the method as set forth in claim 6. The references do not provide any recognition of the advantage of the method set forth in claim 6. At least for such reason, the references cannot be considered to somehow disclose or suggest the subject matter of claim 6. The Office Action does not provide any evidence or even an allegation that the prior art suggests or motivates modification of the cited references to

repeat the process of treating nitrogen oxides wh re a fraction of the first gas NO_x treated to NO_2 in the second gas approximately equals a fraction of the third gas NO_x treated to NO_2 in the fourth gas, as set forth in claim 6. Claim 6 is thus patentable.

Further, for example, claim 9 sets forth that all of the third and fifth gas NO_x is NO. As may be appreciated from the discussion above regarding the deficiencies of the references as applied to claim 1 and the express teachings of Fig. 8 in Vogtlin and '854 along with its associated text, the references do not disclose or suggest all of the NO_x in the processed exhaust of Fig. 3 being NO. Instead, the references expressly describe that the processed exhaust contains NO_2. At least for such reason, the references do not disclose or suggest every limitation of claim 9 and such claim is patentable.

Claim 10 sets forth a NO_x reduction method that includes, among other features, treating a first gas containing NO_x with a first plasma and producing a second gas containing NO_2, reducing a portion of the NO_2 in the second gas to N_2 with a first catalyst and producing a third gas containing less NO_x than the first gas, treating the third gas containing NO_x with a second plasma and producing a fourth gas containing NO_2, and reducing a portion of the NO_2 in the fourth gas to N_2 with a second catalyst and producing a fifth gas containing less NO_x than the third gas. Substantially all of the third gas NO_x is NO. As may be appreciated from the discussion above regarding the deficiencies of the references as applied to claim 1, the references do not disclose or suggest substantially all of the third gas being NO. The references also do not disclose or suggest treating the third gas containing NO_x with a second plasma and reducing a portion of the NO_2 in the fourth gas to N_2 with a second catalyst. At least for such reason, the method of claim 10 is patentable.

Claims 11-23 depend from claim 10 and are pat ntable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claim 12 sets forth that treating the first gas occurs together with reducing NO_2 in the second gas. In contrast, Fig. 3 of the references and elsewhere throughout their text clearly describe that treating NO_x using plasma to produce NO_2 occurs in processor 74 separately from reducing NO_2 to N_2 that occurs either in catalytic converter 78 or catalytic storage reduction reactor 204. The references do not provide any description of treating NO_x to produce NO_2 occurring together with reducing NO_2 to N_2. At least for such reason, claim 12 is patentable.

As may be appreciated from the discussion above regarding the deficiencies of the references as applied to claims 4-6, the references also fail to disclose or suggest the subject matter of respective claims 15-17. Claims 15-17 are thus patentable.

Also for example, claim 22 sets forth that the method further includes controlling energy consumption of the first and second plasmas independent of each other. Claim 23 depends from claim 22 and sets forth that the method further includes substantially minimizing a combined energy consumption of the first and second plasmas. At least paragraph [0037] and the latter part of paragraph [0040] of the present specification describe the new discoveries that led to the methods set forth in claims 22 and 23.

The Office Action alleges that it is obvious to use many stages in the process of treating nitrogen oxides, however, the references can in no way be considered to disclose or somehow suggest the process configurations set forth in claims 22 and 23. The references do not recognize the advantages provided by claims 22 and 23 and further do not recognize the discoveries described in the present specification that led

to understanding the significanc of the proc ss configurations in claims 22 and 23. At least for such reason, claims 22 and 23 are patentable.

Claim 24 sets forth a NO_x reduction methods that includes, among other features, performing a step at least three times in series, the step involving conversion of NO_x contained by an inlet gas to NO_2 with a plasma and catalytically reducing NO_2 at least to N_2 and NO contained by an outlet gas, and operating the at least three performances of the step to plasma convert approximately equal fractions of the inlet gas NO_x to NO_2. As may be appreciated from the discussion above regarding the deficiencies of the references as applied at least to claims 6 and 17, the references do not disclose or suggest any multi-step NO_x reduction method that includes converting approximately equal fractions of inlet gas NO_x to NO_2 in at least three steps of the method. The Office Action does not allege disclosure or suggestion by the cited references of the process configuration set forth in claim 24. The Office Action merely alleges that it would be obvious to use many stages in a nitrogen oxide treatment process. Such allegation is clearly insufficient to properly establish disclosure or suggestion of every limitation set forth in claim 24. At least for such reason, claim 24 is patentable.

Claims 25-29 depend from claim 24 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, as may be appreciated from the discussion above regarding the deficiencies of the references as applied to claims 23, 4, and 5, the references do not disclose or suggest the subject matter set forth in respective claims 26, 28, and 29. At least for such reason, claims 26, 28, and 29 each are patentable.

Applicant herein establishes adequate reasons supporting a finding that claims 1-29 are patentable. Applicant requests allowance of pending claims 1-29 in the next Office Action.

Respectfully submitted,

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